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ABSTRACT

The problem of dissemination and utilization of scientific and technical information (STI) is of particular importance to Canada since it is not a major generator of STI. On the overall basis, it is in fact, one of the largest importers of scientific and technological knowledge. In this presentation Dr. Beaulnes discusses: Approaches to STI systems (information processing and knowledge utilization), Evaluation of STI systems in Canada, Issues and goals, and the Policy options. (Author/SJ)

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SCIENCE POLICY AND STI IN CANADA

A PAPER PRESENTED BY

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TO

CANADIAN ASSOCIATION FOR INFORMATION SCIENCE

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SCIENCE POLICY AND SCIENTIFIC INFORMATION IN CANADA

I. STI AND CANADA - THE CHALLENGE AND MOSST

There are a number of developments which make it necessary for societies to re-examine their scientific and technological information communication facilities. On the one hand, there are rapid increases in national investments in R&D producing a rising volume of STI which by far exceeds the handling and moving capacities of the existing information systems. On the other hand, there is a growing expectation, if not a conviction, that most, if not all, of the world's storehouse of scientific and technological knowledge should be useful to man. This brings about a rapidly rising demand for STI. The problem of dissemination and utilization of STI is of particular importance to Canada since this country is not a major generator of STI. On the overall basis, it is in fact one of the largest "importers" of scientific and technological knowledge.

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To meet the challenge of this situation, the federal government has become involved in promoting knowledge generation and utilization. The formulation of new and improved policies in these fields has been entrusted to the Ministry of State for Science and Technology.

More than a year ago, a special Cabinet Decision specifically directed my Ministry to "review and make recommendations with respect to scientific and technological information systems". In response to this directive, we have undertaken the required review and will soon be ready to make our recommendations. We have developed an acute awareness of the tasks and problems that need to be attended to in developing effective STI services.

II. APPROACHES TO STI SYSTEMS

What are the approaches to STI systems? One much in evidence in contemporary thinking and activities, is to view dissemination of STI as a technical problem of

documentation handling and science information processing.

Another approach is centered on knowledge utilization. Allow me to expand briefly on each of these two approaches.

1. Information Processing Approach

When using the information processing approach and reviewing the operations of the present STI systems, it is evident that STI could be supplied to those who need it much more speedily. This could be achieved not only by the use of computer processing but also by complementary, improved document handling, and better circulation and communication facilities, systems and technologies.

This requires massive introduction of new technologies, substantial expenditure on computerized data processing facilities and radical changes in the skill composition of the operating personnel, some of whom are yet to be found in sufficient numbers.

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This calls for rationalization in the organization and use of scientific documentation and for nation-wide agreements as to the roles and services to be assumed or provided by the various elements forming the STI system.

The knowledge processing approach also calls for research into the logic of analysis, the structure of knowledge, the rules governing establishment of the thesauri and the nature of an optimal documentary language.

However, it fails to take sufficient account of the fact that much of the technological knowledge is neither recorded nor well documented. It does not adequately provide for information needs of a large portion of STI users (mainly those outside basis research). By ignoring their customary ways of acquiring STI, the knowledge processing approach stops short of being concerned with the adoption, assimilation and utilization of S&T knowledge contained in such information.

2. Knowledge Utilization Approach

The need to go beyond the processing aspects of STI and to consider another approach, the knowledge utilization approach,is clearly spelled out in various Canadian references to this topic. The Fifth Annual Report of the Economic Council, for example, in its discussion of the Canadian use of foreign technology, explicitly stresses the need "... to get information to the many thousands of small business firms who are not well equipped to keep in touch with new ideas and new technological developments".

A similar concern is evidenced in the Gray Report on "Domestic Control of the National Economic Environment" which, among other things, recommends that: "A new government information system on technology available from Canada and foreign sources should be established and promoted, to increase the domestic industry's awareness of possible alternative sources of

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technology for Canadian industry. The system should contain information on both proprietory and non-proprietory technology..."

The recent "Lamontagne Report"[1/] is even more explicit when it indicates that for a country like Canada ... the rapid diffusion of new scientific and technological developments is more important than for larger nations ... and that "... a well organized national information service is thus essential ..." Its recommendations concerning STI explicitly refer to, among other things, "dissemination" of scientific and technical information and documentation.

Certainly, the Science Council, in its advice concerning "A Policy for Scientific and Technical Information Dissemination", clearly states that information policy "... is concerned with major strategic decisions on the use of information and information systems in the attainment

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1/ Report of the Senate Special Committee on Science Policy, A Science Policy for Canada, Volume 2, Information Canada, Ottawa, 1972, p. 378.

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of our scientific economic and social objectives by government, industry, universities, schools and other organizations ..." It is, however, only recently that the problem of diffusion and utilization of STI and hence identification of users' information needs and effective ways of satisfying them has begun to attract some attention.

One way to draw your attention to the knowledge utilization aspects of STI is to present a schematic account of how society attends to its needs.

Knowledge generation and utilization takes place in order to satisfy human needs. The process may be depicted as a five stage need-reduction cycle whereby (1) a felt need is articulated as a (2) problem followed by (3) a search for solutions, (4) choice of a solution and (5) the application of the solution which in turn is likely to generate further needs and restart the cycle. The process may be entirely intra-personal as it was for

Robinson Crusoe until he found Friday. Thereafter, it became inter-personal involving two-way communication of messages between Crusoe and his companion.

At the level of social organization, the need-reduction process involves a complex division of labour among people and institutions specializing in certain functions and acting in a variety of roles pertaining to the generation, dissemination and utilization of knowledge. It also involves a variety of integrating forces and highly complex sets of linkage roles and mechanisms. In a simplified form it includes four sets of specialized activities: the basic and applied research, and the development sub-systems as well as the practice and the consumers sub-systems.

The common element to all these activities is that they all involve the acquisition and utilization of large amounts of S&T information. The information types

and needs, however, and hence the flows, are different for each of the complexes comprising the macro-system.

The main concern of the basic research activities complex is why the studied universe behaves the way it does. Its output in the form of theories, supporting data and verification methods pertains to the fundamental understanding of the human environment. This output is thought disseminable when all three elements are synthesized as formal research reports. The use of basic research output does not necessarily involve retrieval of all three.

The major transfer of the results of basic research is usually to other scientists for the generation of additional basic knowledge. The second largest receiver of basic knowledge is the applied R&D sub-system whose main interest is how predictable behaviour may be used for practical purposes, even if the reasons for such behaviour are not known or fully understood. Some of the basic

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knowledge is transmitted to "practitioners", usually as part of the training for their professions. Some finds its way to the consumers' universe through such means as science reporting and thereby allows consumers to develop a scientific orientation towards their environment, or to transform it into their expectations and demands.

Applied R&D is concerned with specific problems of a physical or social nature and it would be most surprising if its information needs coincided with the system of classification designed for the various branches of academic knowledge. Moreover, its inputs include technical and "practice" information.

The output of applied R&D is technological knowledge which in operational form, consists of (in the case of a single technology) "... a set of techniques, each defined as a set of action and decision rules guiding a sequential application that ... will generally lead to a

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predictable (and sometimes desirable) outcome under specified circumstances".[1/] Several forms of R&D knowledge may be transmitted separately. A complete package of R&D data, applied theory and method is represented in "prototypes" of products, processes and organizational structures, some of which are available as patented "commodity". A large portion of an R&D output is "embodied" rather than recorded and for that reason it cannot be adequately attended to by the usual information processing facilities.

The major recipients of R&D knowledge are the "practice" world (service professions, and service and product organizations) where it is tested and progressively adopted until it becomes a "practice knowledge". Most of the "practice knowledge" is embodied in the physical facilities and organization of work of society's goods and service-producing complexes or is residing among various

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1/ Richard R. Nelson, Merton J. Peck, Edward D. Kolachech, Technology, Economic Growth and Public Policy, The Brookings Institution, Washington, 1967 (p.8).

service professionals (i.e., engineers, doctors, accountants, etc.). The acquisition of new knowledge among service professionals may well be lower on their list of concerns than in that of the scientific and R&D communities and their communication within the knowledge dissemination and utilization system is mainly oral. It may be worth referring to the work of Professor Thomas Allen from the MIT on the communication of technical ideas. The Lamontagne report[1/] summarizes his research as follows:

"In reviewing sources of technical ideas, Allen stresses that oral communication dominates as a channel of information, and that the literature including trade magazines as well as professional scientific journals, are not an outstanding source. Unlike his scientific colleague, the average engineer is in fact not equipped to read the journals of his own profession. Thus, according to Allen,

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1/ Report of the Senate Special Committee on Science Policy, A Science Policy for Canada, Volume 2, Information Canada, Ottawa, 1972, p.386.

any system relying for its effectiveness on the provision of written materials to engineers is wasted".

III. EVALUATION OF STI SYSTEMS IN CANADA

In the last six years, the question of Canadian scientific and technical information needs and of systems, networks and services required for their provision, has been subject to some eight or more major research studies (not to speak of the activities of various non-government users' groups and institutions) and it is now accepted that Canada should develop a national decentralized network of STI systems and services capable of providing for the English and French speaking users. Moreover, as part of their operations, the major responsibility for the development of such a network was assigned to the National Library and the National Research Council.

The National Library Act, as assented to in June 1969, provides the National Librarian (under section 7(2) and section 8) with coordinating and implementing

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powers pertaining to federal library services, including STI systems and their extension or linkage with others in and outside of Canada; these powers are without restrictions on subject matter. By virtue of the same Act, the National Librarian (section 7(1)) is also empowered to undertake certain national functions related to maintenance of the national inventory of bibliographical materials, i.e., Union Catalogue of Books, etc.

Following the publication of the recommendations of the "Tyas Group"[1/] and the Science Council's own recommendations, the Cabinet in its decision of December 1969: directed the NRC under the general direction of the National Librarian to "... develop in concert with existing information organizations, a national STI system to encompass the natural sciences and engineering", approved the setting up in the NRC of an Advisory Board on Scientific

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1/ The Science Council of Canada, Scientific and Technical Information in Canada, Special Study No. 8, Parts I and II, Queen's Printer, Ottawa, 1969.

and Technical Information with adequate representation of the National Library. It should be added that the National Library Act also provides for the establishment of a similar body - the National Library Advisory Board.

In a later decision (of July 23, 1970), the Cabinet also assigned to the National Science Library, the responsibility for producing, in cooperation with the Canada Council, an annual repertory of federally funded research projects in the universities covering the natural and social sciences and engineering (Information Exchange Centre).

The various separate initiatives of these institutions, as well as others in the Federal Government and outside, have resulted in some progress in STI matters and have brought certain related issues much closer to the surface.

In the last three years, the National Library and the National Science Library have devoted a large

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amount of effort to the organization, expansion and improvement of their own operations and services, many of which are national in scope.

Following the completion of their Systems Development Project in 1970, concerning "An Intended Information System for the National Library of Canada", the National Library is now concerned with conversion to computer operations. The first to be converted are those systems which pertain to the national services provided by the Library, i.e., the cataloguing sub-systems, which includes the national bibliography, Canadiana Union List of Serials in the Humanities and Social Sciences and eventually the Canadian Union Catalogue. The national services of the National Library have also been extended to include an annual list of Canadian Theses accepted by Canadian universities, a Union list of Non-Canadian newspapers held by Canadian Libraries and the social

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sciences and humanities component of CAN/SDI service being provided by the National Science Library (with major responsibility for natural sciences and engineering).

In cooperation with librarians in and outside the Federal Government a large portion of the National Librarian's effort is being devoted toward the establishment of certain preconditions for planning and building up the national STI network. This involves the development of and agreement on cataloguing (i.e. Task Group on Cataloguing Standards, MARC Task Group, including Canadian MARC Office, Task Group on the Canadian Union Catalogue, etc.), the mapping out of some of the elements of the Canadian bibliographical resource system (i.e. Library Resources Survey, pertaining to research collections in humanities and social sciences in universities' libraries, Survey of Federal Government Libraries), and the strengthening of their own planning organization.

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The National Science Library, a division of NRC, has for a long time considered itself an information transferral agency and thus its efforts continue to be directed toward the enlargement of its access to various national and international STI data bases as well as toward the expansion and improvement of its information transfer facilities and services.

The NRC and its Advisory Board on STI devoted some time to study certain aspects of their directive from Cabinet, undertook to finance some experimental work in the area of specialized data banks, provided a scholarship scheme for advanced training in Library Science. They are now ready to proceed with the establishment of an STI clearing-house for Canadian and foreign semi-formal STI documents and with building up STI Referral Services starting with one regional project on a pilot-project basis.

The Department of Communications has provided considerable support (including funds) to the Canunet Project

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initiated by the Université du Québec and the University of Saskatchewan which examined the technical aspects of certain communication needs of the national STI network. The Department has now come up with federal position papers containing proposals for a Communications Policy for Canada, including a Computer/Communications Policy both of which are of considerable importance to STI policy.

A major concern of the Department of Industry, Trade and Commerce is the technology transfer aspects of STI. They may soon have definite proposals in this regard. The Treasury Board Secretariat on the other hand has already provided in "The EDP Master Plan" that among the various data processing centres envisaged in the plan there will be one exclusively intended as a "Library and Information Retrieval Centre".

Outside the federal government there is an impressive amount of effort devoted to developing specialized data bases and information processing systems which, when

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linked, would provide a very comprehensive national STI network indeed.

One of the reports of the CANUNET Committee[1/] points out that, although their approaches vary, there are at least five universities in Canada developing or operating different types of library systems (University of Toronto, Guelph, Simon Fraser, Université Laval and University of British Columbia). There are major legal systems under development at Queen's, Montréal and Laval. The universities most interested in the Computer-Aided Learning (CAL) Systems are Alberta, Simon Fraser, Western and Toronto. In medical systems, most advanced are the universities of Alberta, Manitoba, Toronto and Dalhousie. There are a number of systems being developed pertaining to survey mapping and land titles (i.e. University of New Brunswick), geodetic surveys (joint project of University of New Brunswick,

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1/ Cowan, D.D., Brewer, N.D., Gotlieb, C.C., MacRae, L.F., Utilization of Computer Networks, A Preliminary Study of the Methods of Using Computer Networks and of Applications which Might be Available over a Computer Network, Prepared for the CANUNET Committee, March 1972.

Bedford Institute and Shell Oil), soil data (British Columbia, Guelph and Laval), geological data (Self Adapting Format Flexible Retrieval and Storage Systems of Western and Alberta Universities), urban and regional planning data banks (University of Sherbrooke and Western Ontario; the latter with assistance from the Department of Regional Economic Expansion), and financial data banks (Financial Research Institute in Montreal).

Resulting from the "CANUNET" project[1/] there is the proposal to establish a universities computer network. The main anticipated obstacles in achieving such a network are said to be organizational and economic. To overcome the latter, the belief is that it "... will be necessary to obtain from the federal sources a substantial part of the operating costs for a period of 3 to 5 years.

My review of various initiatives pertaining to STI is far from complete and I could go on. I hope however

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1/ A Proposal for A CANADIAN UNIVERSITY COMPUTER NETWORK (CANUNET) Prepared by the Canunet Advisory Committee for the Department of Communications, Edited by Université du Québec, March 21, 1972, pp.4 and 5.

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that by now I might have drawn to your attention that:

1. The prevailing concern is with the organization and utilization of library resources and the establishment of computerized data banks.

2. The main orientation appears to be toward processing scientific rather than technological information and thus favours the scientific community which, apart from the information overload problem, is already better provided for than any other user group. The current emphasis on dissemination of scientific rather than technological information is disturbing. There are doubtless historic and situational reasons for it. Perhaps it would be unwise to make any hasty moves to correct the imbalance, and this should not be done at the expense of the scientific component, but there are clearly gaps to be filled and this matter will have to receive special attention.

3. There has been no significant effort to identify STI needs and required services of "... the

increasingly numerous users groups which fall outside the traditional bands of the scientific community..." as suggested by the late Phil Tyas and his colleagues.

4. The various initiatives in the field of STI lack coordinating frameworks and mechanisms and longer-term perspectives as to the future needs. Whatever coordination there is takes place mainly at the technical or operating level of cooperating institutions that belong to different jurisdictions and are subject to a variety of funding systems and different administrative and budgetary controls.

5. The existing arrangements within the federal government, including the legislative and executive provisions concerning the respective roles of the National Librarian, NRC and NSL, did not, to date, prove effective in coordinating the federal effort in STI. The federal STI arrangements, services and initiatives are part of the departmental programs and are yet to be considered in toto and coordinated. There

is as yet no effective framework for such an approach and no machinery to implement it. Yet federal expenditures on scientific information in natural and human sciences in the 1972-73 fiscal year were scheduled to exceed 56 million dollars.

Above all, there is as yet no explicit federal STI policy to guide and implement the federal contribution to the national STI network and until that is developed and the federal proposals for the national policy are prepared, discussed and accepted by the provinces, there is not likely to be much progress in establishing a sufficiently comprehensive and effective system of technology transfer in Canada.

IV. ISSUES AND GOALS

Where do we go from here? This audience, I am sure, recognizes the technical and organizational complexities of the existing STI situation: that there are many elements, many sponsors and many potential users, and that the diverse

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interests and goals of these participants must be considered and reconciled, if at all possible. One basic issue which has to be faced is that of the extent to which overall coordination of existing STI resources is desirable or possible.

A whole set of important issues arise when one tries to define the scope of the STI problem. How broad a view should one take? What kind of activities, what applications, what disciplines, should a national STI system serve? What kinds of subject matters should be included? What are the practical boundaries of the hypothetical system we are discussing? An item of information may have many potential uses and users. The function of an information system is to set problems and answers on collision courses. Is it therefore wise to compartmentalize our thinking along disciplinary lines or to worry about the motivations of enquirers? Do the information needs of the individual components of the research and development

continuum, whether basic, applied, or developmental in emphasis, differ from each other in any fundamental way? Are there fundamental differences between the needs of the natural sciences and engineering, and those of the human sciences? Would it not be wiser, at the policy level, to worry about the solution of society's problems, rather than the needs of compartmentalized activities?

Many of our pressing problems have strong social components: think for just a moment about the so-called population explosion, environmental pollution, energy problems, urban transportation, and so on. Society and governments devote considerable expenditures to the search for solutions to problems of this kind. Would it be wise or practicable to exclude the human sciences from the STI domain, or to neglect relevance to pressing needs of society? More and more technological and societal problems have to be tackled in multi and transdisciplinary melting-pots. Traditional boundaries between

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disciplines, and between pure and applied research, are crumbling and such changes are also being reflected in organizations and in ways of doing things.

Let us look at the view from the lowermost rung of the ladder. The view is rather restricted from here and we could argue that fragmented STI services and facilities exist to provide services and support to other and different programs and activities usually involving scientific research and development. Thus, the funding and growth of STI activities could be operationally linked to decisions made about support of the R&D activities they exist to serve. This attitude is pragmatic, and quite legitimate, but it can be criticized because it is blinkered and does not go far enough. A policy based on this rather laissez-faire attitude neglects the problem of effective overall use of our STI resources and of their orderly future development.

So let us now go to the middle rungs of the

ladder and try to take a somewhat broader view of the situation. We could argue that individual STI services have to remain closely linked to the activities they serve but that something more has to be superimposed. This "something" could be any number of things. It could be new services, national in scope, intended to fill obvious gaps. It could be reinforcement of existing services. It could be technical guidance, research into improved methodologies, provision of communications networks or of computing power; it could be provision of more information analysis services, or of additional STI middle-men to deal with potential users outside the scientific community. Clearly, a policy which calls for superimposed improvements involves fragmented, unbalanced and possible aimless growth. There would be many options here - but how would one choose among the possibilities and make our efforts fit some consistent pattern? In short, where is our sense of direction in all this? <u>If we don't know where we are going, any road will take us there</u>. What we have to do therefore is to

specify where we want to go and how we propose to get there.

Already I think you can see the kinds of available options for the roles of government in STI. For example, it could continue to fund individual services at the program level, much as at present; it could foster piecemeal technical improvements in existing services or it could take a broader view still and enunciate a more comprehensive STI policy. Governments indicate their goals by making policy decisions which provide frameworks for appropriate action. Any STI policy has to take account of current concern about the costs, about the current and future effective overall use of our scientific and technological resources, and the concern about innovation and industrial growth. First, STI policy would therefore have to be consistent with scientific and industrial policies; second, it would have to be directed towards the effective use of existing STI services and resources; and finally it would

have to provide a framework for the fostering of orderly development of improved services.

V. POLICY OPTIONS

The government might decide for example that an appropriate federal role would be that of "facilitating the effective access of individual and institutional clients in all regions of Canada, to appropriate STI services and resources". A policy like this indicates some general direction in which the government might wish to move: within such a framework many options would reamin. Decisions would be needed, for example, on whether the government intended to foster a national decentralized STI service, on the goals to be pursued by such a service, on its form and nature, and on its priorities.

In other words, specific policy goals like "support innovative activities", or "encourage participation from the private sector" would be required, along with guidelines to provide a framework for selection among

multiple choices, for assessing priorities and for determining the scope of any national STI services.

Possible guidelines could take into account factors like "contribution to effective overall use of STI resources"; contribution to services, primarily in support of missions, applications, and the solution of trans-disciplinary problems; contribution to innovative activities; relationship to significant new missions; relationship to existing strength, and to need as demonstrated by significant client involvement in the development of new STI services; relationship to existing well-patronized services; user satisfaction as demonstrated by ability to recover costs. Overall, the guidelines should probably emphasize flexibility and ability to change in response to demonstrated needs.

These then are some of the things to be considered before the question "what policy"? can be answered by the government. We must not neglect another obvious question:

"how is the policy to be carried out?" Questions such as "how may national STI services be organized and developed?" "what principles could guide their evolution and the selection of individual components?" "how are user needs to surface?" and "how is service performance to be evaluated?" all have to be considered.

Clearly, we are considering here a process of evolutionary change likely to take years rather than months. The problem is one in organization and in coordination of multiple interests, in resource allocation and in orderly development in some defined direction. We are dealing with the problem of interrelationships within the complex of loosely-linked interacting STI activity centres, in which changes at one focus can affect other foci in unexpected and unintended ways. In such an illdefined situation, involving multiple choices and uncertainties, it is impossible to specify the future state of the complex in detail or to write a realistic master plan

for future developments. These characteristics have to be considered in any framework for federal STI policy which must therefore provide a framework in which progressive evolutionary changes can occur.

Evolutionary change calls for some feedback mechanism to provide guidance. Let us think of some ways in which the activities of an evolving national STI system could be guided. One likely sense of direction could be obtained from overall science and industrial policy. Another source is derived from the views of the various communities of interest involved: the views of the information transfer community, the views of users and of the generators of STI, the policies and needs of the organizations sponsoring the particular activities, and the views of the tax-payers as expressed through their representatives. The nature of present STI facilities and new initiatives, and the significant involvement of users with them could provide an additional sense of direction, especially if a policy of supporting strength

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were to be adopted. Similarly, the willingness of users to pay for services received provides the basis of other evidence which could be useful in evaluation and guidance, although it is recognized that problems arise because the normal market supply and demand mechanisms do not apply.

Technical guidance and leadership would also be needed. Such things as technical planning, coordination, investigation and development of new techniques, development of standards and provision of advice to users and operators of STI systems, would be included under that heading.

Another big question arises when one asks how such processes are to be administered. What are the organizational options? Recommendations of the various study groups have to be considered and the present division of responsibilities is an important factor also.

In considering the complexity of the present situation, with its numerous participants and roles, the

government may wish to consider whether to reinforce the existing roles of its agents or to restructure them in some degree in the light of events of the past few years. Clearly, an administrative mechanism is required which takes into account the needs of evolving STI services for a continuing high degree of autonomy at the operational level, for some measure of overall guidance, leadership and consultation at the technical level, and for consultation and overall coordination at the policy level. One possible first step would be to undertake a clarification of roles for the purpose of overall coordination of STI services within the Federal Government.

In addition, the particular interests of the various specific operational foci of STI services throughout the nation have to be considered. These include libraries, information and documentation centres, data banks and special services, federal and provincial departments,

universities and industry. In cooperation with them and in consultation with them and their clients, activities might benefit from improved coordination. Gaps must be identified and bridged and emerging initiatives guided in appropriate directions. Obviously this will be a lengthy, delicate and difficult task.

Finally, and by no means least important, the government has to consider the options open to it and the mechanisms available by which STI services of national scope can be funded. There are no operational criteria to indicate appropriate levels of spending, so that suggestions usually amount to an endorsement of current levels of expenditures, or a recommendation that they be raised. One line of argument holds that STI services are primarily provided in support of other programs of expenditure and therefore represent a justifiable overhead on such programs, whether provincial, federal or industrial in nature. This, of course, does not help us decide how much should be spent

in support of services which might be national in scope, such as a national referral service or a national clearing house service.

A number of options do exist: for example, it might be possible to allocate a percentage of the total sum spent on research and development for use in the development of national STI services. Alternatively, a capital fund might be established whose interest would be used to support such national services. Such funds might be administered by affected departments and agencies on a normal program basis, or directly dispersed by Treasury Board aided by the recommendations of an advisory body representing all parties.

At the moment some 5.6% of Federal Government expenditures on scientific activities of all kinds are accounted for by expenditures on scientific information. One option might be to recommend that these expenditures be increased to, say, 7.5% of overall R&D expenditures over the

next few years, subject to some more precise definition of need within, say, five years. Another possibility could be to recommend that some percentage of the total amounts allocated in grants in aid of research, be earmarked specifically for purchase of STI services. Similar provision could be made in contracts placed for R&D services. Such provision might help to encourage the development of an STI capability in Canada outside the Government. Clearly, there is a need for some mechanism whereby "seed money" can be channeled to encourage desirable STI initiatives.

In conclusion I want to emphasize:

First: we are talking about options and related policy matters, about possibilities not certainties.

Second: the function of policy is to provide an overall sense of direction so that subsequent events can unfold in some chosen, consistent, manner.

Third: the existing situation is so complex and future needs so uncertain that it is just not sensible to draw up a

detailed master plan for STI services, at the outset.

Fourth: the appropriate strategy is to choose a framework, or umbrella, within which policies, their interpretation, and their application can be continuously adjusted by a feedback process, to ensure that new developments serve the public interest.

Fifth: the corresponding administrative arrangements, whatever form they eventually take, should reflect and embody this strategy.